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Natural Resource Stewardship and Science

Monitoring Passerine Birds in the Central Alaska Monitoring Network

2013 - 2014 Summary Report for the Central Alaska Vital Signs Monitoring Program

Natural Resource Data Series NPS/CAKN/NRDS—2015/964

ON THE COVER
Researcher hiking in Denali National Park & Preserve.
Photograph by: NPS/Mark Paulson

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Executive Summary

Passerine birds are one of the components of the National Park Service (NPS) Vital Signs Monitoring Program in the Central Alaska Network Monitoring Program (CAKN). Objectives of the CAKN passerine monitoring program include estimating the abundance of passerine birds and detecting trends in their abundance and presence over time.

To meet the monitoring objectives of the CAKN passerine monitoring program, we implemented a monitoring design using temporal repeat surveys and occupancy modeling. Stage I includes conducting a series of repeat bird surveys on roadside bird survey routes. Stage II includes conducting a series of repeat bird surveys on selected minigrids and in other off-road areas.

In 2013 and 2014, we continued with Stage I of the CAKN passerine monitoring program by conducting repeat sampling on the established roadside survey routes along the Denali Park Road in Denali National Park and Preserve (Denali), the McCarthy Road in Wrangell-St. Elias National Park and Preserve (Wrangell-St. Elias), and the Nabesna Road in Wrangell-St. Elias.

The roadside bird surveys routes are similar to those conducted for the North American Breeding Bird Survey (BBS). The surveys started within ½ hour of sunrise and took five to six hours to complete. Each roadside route had 50 sampling points placed approximately 800 m apart. At each roadside sampling point, we conducted a 3-minute point count and recorded all birds heard from the point and all birds seen within ~400m (¼ mile) of the point. Additionally, we recorded how we detected each bird (e.g., singing, calling, displaying, winnowing, drumming, etc.) and in which 1-minute interval we detected it. At each sampling point, we also recorded a series of environmental variables including weather conditions, background noise, insect presence levels and the number of motorized vehicles passing by the point during the survey.

Biologists who were proficient at identifying all birds expected to occur in the area by both visual and aural cues conducted the roadside surveys. The survey crews sampled points on five roadside survey routes between 18 April 2013 and 15 June 2013 and on six roadside survey routes between 17 April 2014 and 25 June 2014. We detected 90 species on the roadside routes in 2013 and 84 species in 2014. Species richness per route ranged from 45 to 51 in 2013 and from 31 to 55 in 2014.

Most detections (78% in 2013 and 75% in 2014) were of members of three families, *Turdidae* (Thrushes), *Parulidae* (Warblers), and *Emberizidae* (Sparrows). White-crowned Sparrow (*Zonotrichia leucophrys*) was the most commonly detected species on the point counts (n=1451, 17.5% of all detections in 2013 and n= 1,617, 17.4% of all detections in 2014).

In 2015, we will continue to conduct roadside surveys in CAKN. We will not implement sampling at off-road sites until biologists working with the NPS Arctic Monitoring Network complete their work on developing more efficient ways to sample at off-road sites.

Acknowledgments

We thank the Central Alaska Monitoring Network (CAKN) for providing financial support for this project, particularly Maggie MacCluskie for her continued support of this project and our efforts at optimizing sampling and analytical methods. We also thank Jeremy Mizel, Margi Dashevsky and Mirjam Noetzli for help with 2013 – 2014 surveys and Nicholas Bywater, CAKN, for continued help with our database.

Background and Introduction

Through the National Park Service (NPS) Vital Signs Monitoring Program, the Central Alaska Network Monitoring Program (CAKN) tracks the major physical drivers of ecosystem change and responses of the two major components of the biota: plants and animals (MacCluskie and Oakley 2005). CAKN identified the distribution and abundance of animals as a focus of the program and included passerine birds as a vital sign as a result.

Over 75% of the terrestrial vertebrate species in CAKN are birds. Birds are an important component of ecosystems and their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems (Fancy and Sauer 2000, O'Connell et al. 2000, Peitz et al. 2002). More than 70% of the bird species in CAKN are land birds. Land bird is a general term used for those species that live or nest primarily in terrestrial habitats.

The land bird monitoring effort in CAKN focuses on species in the order Passeriformes because: 1) many of them are common, 2) they often respond quickly to changes in the environment, 3) many are widely distributed, and 4) many species can be detected using a single survey method. Passerine birds have been the focus of avian monitoring efforts in Denali National Park and Preserve (Denali) since 1992 and the inception of the NPS Inventory and Monitoring Program in 2001. From 1992 to 2008, different surveys and survey techniques were used to collect data on passerine birds in both on-road and off-road locations in Denali as efforts were directed at establishing the most appropriate field techniques to meet the objectives of the monitoring program. Due to the importance of the vital sign and the history of the effort associated with monitoring passerine birds in Denali and elsewhere, we next describe the evolution of the program to the present.

Point counts from 1992 to 2000

From 1992 to 2000, a series of on-road and off-road point counts were conducted in Denali by biologists with the Alaska Bird Observatory (ABO). The NPS Inventory and Monitoring (I&M) Program supported this monitoring when Denali was a prototype I&M park. (The NPS I&M Program also supported the Institute for Bird Populations (IBP) to run Monitoring Avian Productivity and Survivorship (MAPS) stations in Denali during this period as well). During this time, the NPS contracted ABO (and IPB) to conduct all aspects of the passerine monitoring in Denali. For these surveys, the primary data collected was simply the species and number of birds detected at each point. A peer-review of the surveys conducted in Denali from 1992 to 1997 (NPS, unpublished data) highlighted substantial problems associated with using raw counts for monitoring passerine birds. This included problems with estimating the probability of detection. The peer review also identified problems with the lack of a spatial sampling design. In response to the 1997 peer-review and in association with the development of the NPS Vital Signs Monitoring Program, the Denali staff implemented two major changes to the passerine monitoring program in 2002 (Roland et al. 2003).

Point transect surveys from 2002 to 2008

We made three significant changes to the CAKN passerine monitoring program in 2002. First, the NPS decided to directly oversee the passerine monitoring program rather than contract the work to ABO.

Second, following recommendations made by the US Geological Survey (USGS) and the US Fish and Wildlife Service (USFWS) through the Alaska Landbird Monitoring Survey (ALMS), we started sampling using point transect surveys combined with distance sampling to provide estimates of detectability. One of the most important considerations in surveys of any species is that not all individuals are detected during the survey, or the probability of detecting an animal is not 100% (Royle et al. 2007). There is a tremendous volume of literature describing formal procedures for estimating abundance and other demographic parameters in the context of imperfect detection (see Royle et al. 2007). In 2002, distance sampling appeared to be a viable approach to estimating detectability during surveys for passerine birds and this technique was highly recommended by others working on similar monitoring programs in Alaska. Distance sampling accounts for decreasing detection probability as distance from the observer increases and was favored by many as a preferred solution to the problems of simple point counts for birds (Rosenstock et al. 2002, Buckland 2006, Marques et al. 2007). This approach was attractive because it required a single visit by a single observer to estimate abundance at each point, given that individual birds are present and available to be sampled.

Third, we started sampling birds using the newly developed minigrid sampling design to improve spatial sampling inference (Roland et al. 2003). Using this approach, biologists visited sampling points on the minigrids and conducted standardized counts that required them to estimate the distance to each bird detected during the count.

From 2002 to 2008, we conducted point transect surveys with distance sampling on 35 minigrids in Denali. During this time, surveys were conducted by NPS and ABO staff. Twenty-three observers surveyed 1,331 point transects, with 12,623 detections of 80 species.

However, by the late 2000's, research in other areas started to show that the critical assumptions associated with distance sampling for bird surveys may be violated in actual field settings, leading to substantially biased estimates of density and abundance (Alldredge et al. 2007, Bachler and Liechti 2007, Efford and Dawson 2009, Nichols et al. 2009, Simons et al. 2009). These papers raised serious concern regarding the utility of using distance sampling for multispecies point counts in general, especially in complex field settings (Alldredge et al. 2007, Efford and Dawson 2009). For instance, some species tended to move away from the observer violating the assumption of perfect detection at the center of the plot, directionality of vocalizations can cause substantial distance measurement errors, and measurement errors may increase in a nonlinear fashion relative to distance (Alldredge et al. 2007). These errors could cause large and unpredictable bias in density and abundance estimates, dramatically decreasing their value for long-term monitoring. Based on these findings, we stopped using point transect surveys in 2009, initiated a review of our passerine data collected in Denali from 2002 to 2008 (see below), and also re-instated the repeat roadside surveys.

In 2009, we also switched our field efforts to sampling on the roadside surveys that were originally sampled by the ABO in the mid-1990s. ABO conducted North American Breeding Bird Survey (BBS) style counts on roadside routes to determine seasonal variation in detection probabilities (Paton and Pogson 1996), so in 2009 NPS biologists conducted standardized 3-minute point counts at sampling points along the Denali Park road several times during the breeding season (late April through early July). In 2009, we also experimented with other field techniques for sampling at off-road sites, but abandoned these efforts in 2010 due to logistic constraints.

Analysis of Denali data from 2002 to 2008

The objectives of the analyses conducted by Hoekman and Lindberg (2012) included: 1) assessing adherence to assumptions of distance sampling, 2) examine factors influencing detection probabilities, 3) estimate density across years and habitats, and 4) examine statistical power to detect future population declines. The analysis of the Denali data collected using distance sampling from 2002 to 2008 provided strong evidence of major violations of the assumptions of distance sampling (Hoekman and Lindberg 2012) and suggested that we need to make another significant change to the program. For instance, of the 14 species with sufficient samples for analyses, Hoekman and Lindberg (2012) found that all 5 species of thrushes as well as Arctic Warblers, Fox Sparrows, and Dark-eyed Juncos showed a relative surplus of detections at intermediate distances (~40-70 m). This pattern likely arose from bird evasion of observers and/or error in distance estimation. Resulting violations of critical assumptions of distance sampling were uncorrectable; hence, these species were unsuitable for distance sampling analyses. Estimated detection functions for six remaining species adequately met assumptions when data were pooled across years. However, Hoekman and Lindberg (2012) found large variation in detection functions relative to year, habitat type, and wind speed. Resulting functions often severely violated assumptions of methods, were biologically implausible, and were inconsistent across species and with our predictions.

Hoekman and Lindberg (2012) also found consistent differences in detection functions relative to individual observers. Observers often had surpluses or deficits of observations at specific distances, most likely as a result of error and bias in distance estimates to birds detected only by auditory cues. Hoekman and Lindberg (2012) concluded estimates of detection probability, and hence density, were likely subject to large bias and variability. Furthermore, Hoekman and Lindberg (2012) failed to identify satisfactory remedies and felt density estimates from these data would be uninformative. Even if potential bias in year-specific estimates was ignored, power analyses suggested current methods and levels of sampling effort would be unlikely to meet the monitoring goal of >80% power to detect a 50% population decline over 20 years for multiple species.

Hoekman and Lindberg (2012) concluded that characteristics of Denali made distance sampling methods inappropriate for monitoring populations of passerines and that impediments would be difficult or impossible to overcome. Further, estimating the distance to birds that are detected solely by aural cues is problematic. Hoekman and Lindberg (2012) recommended that we make another significant change to our sampling approach and use methods allowing for the estimation of probability of detection that do not rely on estimation of distance to birds and that will be relatively insensitive to evasive movements by birds.

Current monitoring efforts

Our current monitoring efforts are focused on data collected on a series of roadside survey routes in Denali and Wrangell-St. Elias. Biologists with the NPS Arctic Monitoring Network are conducting a project to test new field and analytical techniques for improving the efficiency of sampling at off-road sites, and we will implement sampling at off-road sites only after that project is completed.

Binomial mixture models enable generation of detectability-corrected-abundance estimates from count data, and they require data that are easier to collect than distance sampling or other methods of estimating detectability (Kery et al. 2005). The key requirement of these models is the temporal replication of counts (or temporal repeat surveys) at a number of sample locations (Kery et al. 2005).

Our current sampling approach involves conducting a series of standardized bird surveys across the nesting season on roadside survey routes in CAKN using similar methods employed by BBS (Sauer et al. 2008). A recent analysis of data collected using a temporal repeat count approach along several roadside bird surveys on the Denali Park Road from 1993 to 1998, in 2006, and in 2009 suggested that this technique will allow us to meet our monitoring objectives (Schmidt et al. 2013) without violating assumptions of the data analyses techniques.

Repeated counts and recently developed hierarchical N-mixture models (Royle 2004) avoid many of the problems encountered with distance sampling and unadjusted point counts by separately estimating detection probability and abundance. These mixture models build on methods developed for occupancy estimation (Royle and Nichols 2003, MacKenzie et al. 2006) and separate the abundance process from the observation process. Further, this approach will allow us to detect changes in dates of first detections of each species and in the probability of detecting species across the survey period and within the survey day, measurements that are important for identifying potential impacts of a warming climate on changes in breeding season phenology for birds (Both and te Marvelde 2007).

In 2013 and 2014, we continued to implement passerine monitoring in two of the three network parks and conducted a series of temporal repeat surveys along roadside routes in Denali and Wrangell-St. Elias. The purpose of this progress report is to describe the fieldwork conducted and to provide a brief summary of the data collected in 2013 and 2014.

Methods

Passerine Monitoring Objectives

Our primary objective is to detect changes in a series of metrics associated with the distribution, presence, abundance, and peak detection times of a suite of passerine birds over time. The following metrics are measured annually: 1) first, peak, and last annual detection dates, 2) peak detection times within daily and annual sampling periods, 3) occupancy (presence).

We focused our fieldwork in 2013 and 2014 on:

- Surveying three roadside bird survey routes in Denali;
- Surveying two roadside survey routes along the McCarthy Road and one roadside survey route along the Nabesna Road in Wrangell-St. Elias.

The roads mentioned in this report are generally smaller two-lane gravel roads with relatively low traffic volumes (less than one vehicle per survey hour) during the time we conduct the surveys.

Conducting the Surveys

Our sampling methods for roadside surveys generally followed those developed for the BBS. The main difference between the BBS and CAKN roadside surveys is that the roadside CAKN surveys are conducted at least three times during the nesting season and included measurements of the time of detection, the type of detection, and a series of environmental variables at each sampling point.

We standardized surveys to reduce variation in detection probability by starting each survey within 0.5 hours of sunrise, finishing each survey within ~6 hours, and surveying only one roadside route per day per person. We did not conduct surveys during periods of precipitation or when wind speed was >13kph because rain and higher winds influenced our ability to detect birds, both by influencing bird behavior and our hearing.

At each roadside point, we conducted a three-minute count and recorded all birds heard from the point and all birds seen within ~400m (¼ mile) of the point. For each detection, we identified the species, the type of detection, and the time of detection. We identified all birds to species except for scaup and redpolls. Because it is often very difficult to differentiate between Greater Scaup or Lesser Scaup and Common Redpoll and Hoary Redpoll without detailed observation of the bird, these were identified as Scaup species (spp.) and Redpoll species (spp.). Type of detection included: singing, calling, visual, fly-over, drumming, winnowing, aerial display - aural, and aerial display - visual. In the case where a bird could not be identified, we recorded it as an unidentified bird.

At each survey point, we also recorded a series of environmental variables including weather conditions (wind speed and direction, temperature, cloud cover, precipitation), background noise, insect presence, and the number of motorized vehicles heard or seen during the count. Additionally, we recorded bird species detected between points and the number of adult Snowshoe Hare (*Lepus americanus*) detected between points.

Our goal was to survey the eastern most Denali roadside route (route 1) at least once every ten days starting in late April and ending in late June and the remainder of the roadside routes at least three times between late May and late June. We developed our temporal sampling plan to rotate observers across the routes and to survey the routes in opposite directions (starting at the last point and ending at the first point) at least once during the season.

Scientific names of bird species mentioned in this report are listed in Appendix A and not within the text of this report. Phylogenetic sequence, English and scientific names follow *The A.O.U. Check-list of North American Birds* (7th ed., American Ornithologists Union 1998) and supplements through 2014 (Chesser et al. 2014).

Results and Discussion

Survey Effort

The 2013 survey team consisted of Carol McIntyre (NPS), Mark Paulson (NPS) and Jason Reppert (NPS). All sampling occurred from 18 April 2013 to 15 June 2013 (Table 1). The 2014 survey team consisted of Carol McIntyre (NPS), Mark Paulson (NPS), Jason Reppert (NPS), and Jeremy Mizel (NPS). All sampling was completed from 17 April 2014 to 25 June 2014 (Table 2). For both years, most surveys started within ½ hour of sunrise and ended within five hours of the start.

We did not survey the Nabesna Road in 2013 due to a road washout in late May. We also missed surveying the roadside routes in Denali in June 2014 due to unforeseen illness of the primary observer.

Detection Types and Times

As expected, most detections were of vocalizing (singing or calling) birds (93.9% in 2013 and 92.4% in 2014; Table 5). Most detections (97.7% in 2013 and 97.6% in 2014) were of individual birds rather than pairs or flocks, with a maximum flock size of 15 redpolls in 2013 and 30 Tundra Swans in 2014. Most detections occurred within the first minute of the point counts (67.3% in 2013 and 66.9% in 2014).

Species Diversity and Detections across Routes

The number of species detected on each route ranged from 45 to 51 in 2013 and 31 to 55 in 2014 (Tables 3 and 4). Pooling across all survey routes, we detected 90 species in 2013, including 48 species in the order Passeriformes, and 84 species in 2014, including 47 passerine species (Tables 3 and 4).

Wilson's Snipe, Gray Jay, Ruby-crowned Kinglet, Swainson's Thrush, American Robin, Orange-crowned Warbler, Yellow-rumped Warbler, Wilson's Warbler, Savannah Sparrow, Fox Sparrow, Lincoln's Sparrow, White-crowned Sparrow and Dark-eyed Junco were detected on all routes in both 2013 and 2014 (Table 6). In addition, Common Raven and Hermit Thrush were detected on all routes in 2013 and Boreal Chickadee, Varied Thrush and Redpoll spp. were detected on all routes in 2014. The frequency of these detections varied across routes (Tables 6). In both years, four of the passerine species were only detected once including Hammond's Flycatcher, Northern Shrike, Violet-green Swallow and Golden-crowned Kinglet in 2013 and Hammond's Flycatcher, Say's Phoebe, Townsend's Solitaire and Tennessee Warbler in 2014 (Table 6). Tennessee Warbler was detected on both McCarthy road routes in 2014.

White-crowned Sparrow was the most commonly detected species both years (1,617 detections or 17.4% of all detections in 2013; 1,450 detections or 17.5% in 2014). White-crowned Sparrow was the most commonly detected species on all roadside routes in Denali in 2013 and 2014 as well as on Nabesna Road in 2014 (not surveyed 2013). Swainson's Thrush was the most commonly detected species on both of the McCarthy Road routes in 2013. Yellow-rumped Warbler and Dark-eyed Junco were each the most commonly detected species on one of the McCarthy Road routes in 2014.

To compare detections of species across the roadside surveys in CAKN, we standardized the number of detections by the number of points and the number of repeat surveys per route (Tables 3 and 4). The differences in the presence and rate of detection of different species among routes are most likely due to the differences in habitat on the routes. For instance, the roadside routes in Wrangell-St. Elias were mainly in boreal forest while the roadside routes in Denali were mainly in subalpine scrublands and alpine areas.

There were very few (< 0.1% of detections) unknown birds reported either year. Detections of birds used in the summary these data do not include birds detected between points or before or after a survey or birds farther than 400 meters away from point, only birds detected within the 3-minute point counts.

Plans for 2015

- Complete at least eight repeats on Denali roadside survey 1 from mid-April to late June.
- Complete at least one survey on the Wrangell-St. Elias roadside routes in early and mid-May.
- Complete at least four repeat surveys on all other roadside surveys in from late May to late June and at least two repeat surveys on all roadside surveys from late May to late June in Wrangell-St. Elias.
- Begin exploring analytical techniques for detecting changes in occupancy of less common passerine species.
- Continue data analyses for data collected from 2010 to 2015 including manuscript preparation on shifts in elevation and phenology.

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Table 1. Observer counts competed for the roadside bird survey routes, Central Alaska Monitoring Network passerine monitoring program, Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Alaska, 2013.

Observer	Routes surveyed 2013	Counts completed
Carol McIntyre	All Denali Roadside Routes	150
Mark Paulson	All Denali Roadside Routes	850
Jason Reppert	All Denali and McCarthy Roadside Routes	400

Table 2. Observer counts competed for the roadside bird survey routes, Central Alaska Monitoring Network passerine monitoring program, Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Alaska, 2014.

Observer	Routes surveyed 2014	Counts completed
Carol McIntyre	All Routes except Denali Roadside 2	287
Jeremy Mizel	Denali Roadside 1, Both McCarthy, Nabesna	250
Mark Paulson	All Denali Roadside Routes	224
Jason Reppert	All Denali and McCarthy Roadside Routes	276

Table 3. Roadside repeat bird sampling routes, sampling dates, number of repeat surveys, and species per route for the Central Alaska Monitoring Network passerine monitoring program, Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Alaska, 2013.

Route name	Sampling period	Points on route	# of repeat surveys	Number of species
Denali Roadside 1	18 April - 23 June	50	10	47
Denali Roadside 2	1 May - 24 June	50	8	51
Denali Roadside 3	31 May - 25 June	50	4	47
McCarthy Roadside 1	10 June - 14 June	50	3	48
McCarthy Roadside 2	11 June - 15 June	50	3	45

Table 4. Roadside repeat bird sampling routes, sampling dates, number of repeat surveys, and species per route for the Central Alaska Monitoring Network passerine monitoring program, Denali National Park and Preserve, Wrangell-St. Elias National Park and Preserve, and Yukon-Charley Rivers National Preserve, Alaska, 2014.

Route name	Sampling period	Points on route	# of repeat surveys	Number of species
Denali Roadside 1	17 April – 28 May	50	5	33
Denali Roadside 2	13 May - 28 May	50	3	31
Denali Roadside 3	15 May - 25 June	50	4	48
McCarthy Roadside 1	10 May - 3 June	50	3	55
McCarthy Roadside 2	9 May - 4 June	50	3	42
Nabesna Roadside 1	8 May - 30 May	50	3	38

Table 5. Summary of percentage of detections by detection type in 2013 and 2014, CAKN passerine monitoring program.

Type of detection	2013	2014
Singing	78.9	75.8
Calling	14.5	14.8
Visual	3.7	4
Fly-over	2.1	2.9
Drumming	0.2	0.2
Winnowing	0.1	0.3
Aerial display - aural	0.4	1.8
Aerial display - visual	0	0

Table 6. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2013. The route names are Denali Roadside 1 = DR1, Denali Roadside 2 = DR2, Denali Roadside 3 = DR3, McCarthy Roadside 1 = MR1, McCarthy Roadside 2 = MR2, and Nabesna Roadside 1 = NR1.

Common Name	DR1	DR2	DR3	MR 1	MR 2
Snow Goose	0.024	0.000	0.000	0.000	0.000
Canada Goose	0.000	0.007	0.000	0.000	0.000
Trumpeter Swan	0.004	0.000	0.000	0.053	0.007
Tundra Swan	0.060	0.000	0.000	0.000	0.000
American Wigeon	0.000	0.000	0.005	0.000	0.000
Mallard	0.000	0.000	0.030	0.000	0.007
Northern Shoveler	0.000	0.000	0.005	0.000	0.000
Northern Pintail	0.000	0.000	0.005	0.000	0.000
Green-winged Teal	0.008	0.000	0.015	0.000	0.000
Scaup sp	0.000	0.000	0.015	0.027	0.000
Harlequin Duck	0.000	0.007	0.000	0.000	0.000
Bufflehead	0.000	0.000	0.015	0.000	0.000
Barrow's Goldeneye	0.000	0.000	0.040	0.007	0.000
Spruce Grouse	0.004	0.040	0.000	0.000	0.000
Willow Ptarmigan	0.420	1.707	0.335	0.000	0.000
Rock Ptarmigan	0.000	0.013	0.035	0.000	0.000
Common Loon	0.000	0.000	0.000	0.007	0.000
Osprey	0.000	0.000	0.000	0.007	0.000
Bald Eagle	0.000	0.000	0.000	0.027	0.007
Northern Harrier	0.008	0.007	0.015	0.000	0.000
Red-tailed Hawk	0.000	0.007	0.000	0.000	0.013
Golden Eagle	0.008	0.033	0.020	0.000	0.000
Merlin	0.032	0.020	0.005	0.007	0.000
Gyrfalcon	0.000	0.007	0.000	0.000	0.000
Sora	0.000	0.000	0.000	0.007	0.000
Solitary Sandpiper	0.000	0.000	0.000	0.047	0.040
Wandering Tattler	0.000	0.000	0.005	0.000	0.000
Lesser Yellowlegs	0.004	0.000	0.000	0.013	0.000
Whimbrel	0.044	0.007	0.000	0.000	0.000
Surfbird	0.000	0.027	0.020	0.000	0.000
Wilson's Snipe	0.008	0.020	0.030	0.020	0.007
Bonaparte's Gull	0.000	0.000	0.005	0.000	0.000
Mew Gull	0.128	0.093	0.035	0.013	0.000
Herring Gull	0.000	0.000	0.000	0.080	0.000
Long-tailed Jaeger	0.000	0.093	0.010	0.000	0.000
Great Horned Owl	0.000	0.007	0.000	0.000	0.000
Northern Hawk Owl	0.008	0.000	0.000	0.000	0.000
Short-eared Owl	0.000	0.047	0.015	0.000	0.000
Belted Kingfisher	0.000	0.000	0.000	0.013	0.013

Table 6. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2013. (continued)

Common Name	DR1	DR2	DR3	MR 1	MR 2
Hairy Woodpecker	0.008	0.013	0.000	0.013	0.013
American Three-toed Woodpecker	0.000	0.000	0.000	0.000	0.007
Black-backed Woodpecker	0.000	0.000	0.000	0.000	0.007
Northern Flicker	0.008	0.013	0.000	0.027	0.007
Olive-sided Flycatcher	0.000	0.000	0.000	0.013	0.027
Western Wood-Pewee	0.000	0.000	0.000	0.113	0.073
Alder Flycatcher	0.000	0.000	0.005	0.233	0.080
Hammond's Flycatcher	0.000	0.000	0.000	0.000	0.007
Northern Shrike	0.000	0.007	0.000	0.000	0.000
Gray Jay	0.288	0.267	0.010	0.200	0.367
Black-billed Magpie	0.128	0.640	0.060	0.000	0.000
Common Raven	0.092	0.047	0.010	0.040	0.020
Horned Lark	0.000	0.000	0.020	0.000	0.000
Tree Swallow	0.000	0.000	0.000	0.053	0.107
Violet-green Swallow	0.004	0.000	0.000	0.000	0.000
Black-capped Chickadee	0.032	0.053	0.000	0.040	0.087
Boreal Chickadee	0.164	0.107	0.005	0.000	0.000
Golden-crowned Kinglet	0.004	0.000	0.000	0.000	0.000
Ruby-crowned Kinglet	0.240	0.333	0.005	0.373	0.480
Arctic Warbler	0.004	0.140	0.175	0.000	0.000
Northern Wheatear	0.000	0.020	0.000	0.000	0.000
Gray-cheeked Thrush	0.092	0.020	0.025	0.000	0.007
Swainson's Thrush	0.296	0.287	0.025	2.047	2.347
Hermit Thrush	0.016	0.227	0.095	0.153	0.007
American Robin	0.324	0.580	0.010	0.927	0.740
Varied Thrush	0.184	0.340	0.000	0.040	0.253
American Pipit	0.000	0.013	0.040	0.000	0.000
Bohemian Waxwing	0.000	0.000	0.000	0.047	0.013
Lapland Longspur	0.000	0.007	0.005	0.000	0.000
Snow Bunting	0.000	0.013	0.000	0.000	0.000
Northern Waterthrush	0.008	0.000	0.000	0.033	0.047
Tennessee Warbler	0.000	0.000	0.000	0.007	0.020
Orange-crowned Warbler	0.396	0.753	0.585	0.253	0.467
Yellow Warbler	0.012	0.000	0.040	0.053	0.013
Blackpoll Warbler	0.052	0.007	0.000	0.000	0.040
Yellow-rumped Warbler	0.484	0.607	0.020	1.127	1.333
Wilson's Warbler	0.376	0.400	0.585	0.047	0.100
American Tree Sparrow	1.588	2.240	1.415	0.007	0.000
Chipping Sparrow	0.000	0.000	0.000	0.073	0.060
Savannah Sparrow	0.168	0.427	0.620	0.127	0.080
Fox Sparrow	1.200	1.000	0.910	0.207	0.007

Table 6. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2013. (continued)

Common Name	DR1	DR2	DR3	MR 1	MR 2
Lincoln's Sparrow	0.092	0.280	0.035	0.133	0.067
White-crowned Sparrow	2.248	3.427	1.825	0.767	0.407
Golden-crowned Sparrow	0.008	0.120	0.170	0.000	0.000
Dark-eyed Junco	0.780	0.793	0.160	1.060	1.027
Rusty Blackbird	0.000	0.000	0.000	0.027	0.013
Gray-crowned Rosy Finch	0.000	0.027	0.000	0.000	0.000
Pine Grosbeak	0.000	0.000	0.000	0.053	0.033
White-winged Crossbill	0.024	0.040	0.000	0.120	0.027
Common Redpoll	0.004	0.000	0.000	0.000	0.000
Redpoll sp.	0.624	0.527	0.535	0.000	0.000
Pine Siskin	0.000	0.000	0.000	0.140	0.100
Unknown bird	0.020	0.047	0.030	0.020	0.033

Table 7. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2014. The route names are Denali Roadside 1 = DR1, Denali Roadside 2 = DR2, Denali Roadside 3 = DR3, McCarthy Roadside 1 = MR1, McCarthy Roadside 2 = MR2, and Nabesna Roadside 1 = NR1.

Common Name	DR1	DR2	DR3	MR 1	MR 2	NR1
Canada Goose	0.000	0.000	0.000	0.007	0.000	0.000
Trumpeter Swan	0.000	0.000	0.000	0.013	0.007	0.000
Tundra Swan	0.120	0.000	0.000	0.000	0.000	0.000
Gadwall	0.000	0.000	0.000	0.013	0.000	0.000
American Wigeon	0.000	0.000	0.000	0.007	0.000	0.027
Mallard	0.000	0.000	0.000	0.040	0.020	0.007
Northern Shoveler	0.000	0.000	0.025	0.000	0.000	0.007
Northern Pintail	0.000	0.000	0.020	0.000	0.000	0.000
Green-winged Teal	0.000	0.000	0.000	0.027	0.007	0.000
Scaup sp	0.000	0.000	0.020	0.100	0.000	0.000
Bufflehead	0.000	0.000	0.000	0.013	0.000	0.007
Barrow's Goldeneye	0.000	0.000	0.010	0.020	0.000	0.000
Spruce Grouse	0.008	0.000	0.000	0.000	0.000	0.000
Willow Ptarmigan	0.244	0.567	0.485	0.000	0.000	0.020
Rock Ptarmigan	0.000	0.020	0.040	0.000	0.000	0.000
Pacific Loon	0.000	0.000	0.000	0.007	0.000	0.000
Common Loon	0.000	0.000	0.000	0.013	0.000	0.000
Bald Eagle	0.000	0.000	0.000	0.000	0.007	0.000
Northern Harrier	0.012	0.000	0.015	0.000	0.000	0.000
Red-tailed Hawk	0.000	0.000	0.000	0.000	0.000	0.013
Golden Eagle	0.000	0.027	0.040	0.000	0.000	0.000
American Kestrel	0.000	0.000	0.000	0.000	0.000	0.007

Table 7. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2014. (continued)

Common Name	DR1	DR2	DR3	MR 1	MR 2	NR1
Merlin	0.008	0.000	0.015	0.000	0.000	0.000
Peregrine Falcon	0.000	0.000	0.000	0.000	0.007	0.000
Solitary Sandpiper	0.000	0.000	0.000	0.040	0.007	0.007
Wandering Tattler	0.000	0.000	0.020	0.000	0.000	0.000
Lesser Yellowlegs	0.000	0.007	0.000	0.033	0.033	0.000
Whimbrel	0.004	0.007	0.005	0.000	0.000	0.000
Surfbird	0.000	0.027	0.005	0.000	0.000	0.000
Wilson's Snipe	0.032	0.020	0.040	0.053	0.047	0.093
Bonaparte's Gull	0.000	0.000	0.000	0.000	0.000	0.007
Mew Gull	0.064	0.047	0.045	0.007	0.000	0.027
Herring Gull	0.000	0.000	0.000	0.027	0.000	0.000
Great Horned Owl	0.000	0.000	0.000	0.000	0.013	0.000
Short-eared Owl	0.000	0.000	0.015	0.000	0.000	0.000
Hairy Woodpecker	0.000	0.000	0.000	0.013	0.000	0.000
American Three-toed Woodpecker	0.004	0.000	0.000	0.000	0.020	0.007
Northern Flicker	0.012	0.000	0.000	0.013	0.093	0.040
Olive-sided Flycatcher	0.000	0.000	0.000	0.040	0.053	0.007
Western Wood-Pewee	0.000	0.000	0.000	0.033	0.020	0.000
Alder Flycatcher	0.000	0.000	0.015	0.007	0.027	0.000
Hammond's Flycatcher	0.000	0.000	0.000	0.007	0.000	0.000
Say's Phoebe	0.000	0.007	0.000	0.000	0.000	0.000
Northern Shrike	0.000	0.000	0.015	0.000	0.000	0.000
Gray Jay	0.176	0.067	0.010	0.120	0.167	0.340
Black-billed Magpie	0.068	0.127	0.155	0.000	0.000	0.000
Common Raven	0.036	0.000	0.015	0.040	0.040	0.040
Horned Lark	0.000	0.000	0.010	0.007	0.000	0.000
Tree Swallow	0.000	0.000	0.005	0.007	0.040	0.000
Violet-green Swallow	0.000	0.000	0.000	0.027	0.027	0.013
Bank Swallow	0.000	0.000	0.000	0.060	0.000	0.000
Black-capped Chickadee	0.000	0.000	0.005	0.020	0.000	0.000
Boreal Chickadee	0.096	0.027	0.005	0.133	0.080	0.100
Ruby-crowned Kinglet	0.088	0.053	0.010	0.900	1.033	0.707
Arctic Warbler	0.000	0.000	0.125	0.000	0.000	0.000
Northern Wheatear	0.000	0.020	0.015	0.000	0.000	0.000
Townsend's Solitaire	0.000	0.000	0.000	0.007	0.000	0.000
Gray-cheeked Thrush	0.008	0.000	0.010	0.013	0.000	0.020
Swainson's Thrush	0.052	0.020	0.015	0.740	0.853	0.120
Hermit Thrush	0.000	0.053	0.040	0.073	0.007	0.000
American Robin	0.172	0.247	0.015	1.000	1.027	1.113
Varied Thrush	0.236	0.160	0.005	0.107	0.527	0.233
American Pipit	0.000	0.000	0.060	0.000	0.000	0.000
Bohemian Waxwing	0.000	0.000	0.000	0.080	0.047	0.007

Table 7. Detections of each species per point per repeated survey on the Roadside survey routes in the Central Alaska Monitoring Network, 2014. (continued)

Common Name	DR1	DR2	DR3	MR 1	MR 2	NR1
Lapland Longspur	0.000	0.000	0.020	0.000	0.000	0.000
Northern Waterthrush	0.000	0.000	0.000	0.113	0.033	0.000
Tennessee Warbler	0.000	0.000	0.000	0.000	0.007	0.000
Orange-crowned Warbler	0.076	0.200	0.520	0.313	0.400	0.167
Yellow Warbler	0.000	0.000	0.035	0.020	0.027	0.027
Blackpoll Warbler	0.000	0.000	0.010	0.013	0.020	0.007
Yellow-rumped Warbler	0.320	0.287	0.005	1.247	1.793	0.613
Wilson's Warbler	0.076	0.133	0.415	0.087	0.060	0.300
American Tree Sparrow	0.960	1.487	1.265	0.000	0.000	0.000
Savannah Sparrow	0.128	0.287	0.695	0.067	0.047	0.040
Fox Sparrow	0.648	0.600	0.825	0.320	0.020	0.060
Lincoln's Sparrow	0.016	0.080	0.055	0.287	0.253	0.167
White-crowned Sparrow	1.244	1.927	1.540	1.227	0.647	1.740
Golden-crowned Sparrow	0.004	0.073	0.150	0.000	0.007	0.000
Dark-eyed Junco	0.532	0.580	0.065	1.687	1.487	1.353
Rusty Blackbird	0.004	0.000	0.000	0.060	0.013	0.013
Pine Grosbeak	0.000	0.000	0.000	0.027	0.047	0.000
White-winged Crossbill	0.088	0.027	0.000	0.000	0.000	0.000
Common Redpoll	0.000	0.000	0.000	0.007	0.000	0.013
Redpoll sp.	1.136	0.680	0.440	0.067	0.073	0.160
Pine Siskin	0.000	0.000	0.000	0.020	0.000	0.000
Unknown bird	0.008	0.027	0.005	0.073	0.040	0.040

Appendix A. Common and scientific names of species mentioned in this report.

Scientific Name	Common Name
Chen caerulescens	Snow Goose
Branta canadensis	Canada Goose
Cygnus buccinator	Trumpeter Swan
Cygnus columbianus	Tundra Swan
Anas strepera	Gadwall
Anas americana	American Wigeon
Anas platyrhynchos	Mallard
Anas clypeata	Northern Shoveler
Anas acuta	Northern Pintail
Anas crecca	Green-winged Teal
Aythya sp	Scaup sp
Histrionicus histrionicus	Harlequin Duck
Bucephala albeola	Bufflehead
Bucephala islandica	Barrow's Goldeneye
Falcipennis canadensis	Spruce Grouse
Lagopus lagopus	Willow Ptarmigan
Lagopus muta	Rock Ptarmigan
Gavia pacifica	Pacific Loon
Gavia immer	Common Loon
Pandion haliaetus	Osprey
Haliaeetus leucocephalus	Bald Eagle
Circus cyaneus	Northern Harrier
Buteo jamaicensis	Red-tailed Hawk
Aquila chrysaetos	Golden Eagle
Falco sparverius	American Kestrel
Falco columbarius	Merlin
Falco rusticolus	Gyrfalcon
Falco peregrinus	Peregrine Falcon
Porzana carolina	Sora
Tringa solitaria	Solitary Sandpiper
Tringa incana	Wandering Tattler
Tringa flavipes	Lesser Yellowlegs
Numenius phaeopus	Whimbrel
Calidris virgata	Surfbird
Gallinago delicata	Wilson's Snipe
Chroicocephalus philadelphia	Bonaparte's Gull
Larus canus	Mew Gull
Larus argentatus	Herring Gull
Stercorarius longicaudus	Long-tailed Jaeger
Bubo virginianus	Great Horned Owl

Appendix A. Common and scientific names of species mentioned in this report (continued).

Scientific Name	Common Name
Surnia ulula	Northern Hawk Owl
Asio flammeus	Short-eared Owl
Megaceryle alcyon	Belted Kingfisher
Picoides pubescens	Downy Woodpecker
Picoides villosus	Hairy Woodpecker
Picoides dorsalis	American Three-toed Woodpecker
Picoides arcticus	Black-backed Woodpecker
Colaptes auratus	Northern Flicker
Contopus cooperi	Olive-sided Flycatcher
Contopus sordidulus	Western Wood-Pewee
Empidonax alnorum	Alder Flycatcher
Empidonax hammondii	Hammond's Flycatcher
Sayornis saya	Say's Phoebe
Lanius excubitor	Northern Shrike
Perisoreus canadensis	Gray Jay
Pica hudsonia	Black-billed Magpie
Corvus corax	Common Raven
Eremophila alpestris	Horned Lark
Tachycineta bicolor	Tree Swallow
Tachycineta thalassina	Violet-green Swallow
Riparia riparia	Bank Swallow
Poecile atricapillus	Black-capped Chickadee
Poecile hudsonicus	Boreal Chickadee
Regulus satrapa	Golden-crowned Kinglet
Regulus calendula	Ruby-crowned Kinglet
Phylloscopus borealis	Arctic Warbler
Oenanthe oenanthe	Northern Wheatear
Myadestes townsendi	Townsend's Solitaire
Catharus minimus	Gray-cheeked Thrush
Catharus ustulatus	Swainson's Thrush
Catharus guttatus	Hermit Thrush
Turdus migratorius	American Robin
Ixoreus naevius	Varied Thrush
Anthus rubescens	American Pipit
Bombycilla garrulus	Bohemian Waxwing
Calcarius lapponicus	Lapland Longspur
Plectrophenax nivalis	Snow Bunting
Parkesia noveboracensis	Northern Waterthrush
Oreothlypis peregrina	Tennessee Warbler
Oreothlypis celata	Orange-crowned Warbler
Setophaga petechia	Yellow Warbler
Setophaga coronata	Yellow-rumped Warbler

Appendix A. Common and scientific names of species mentioned in this report (continued).

Scientific Name	Common Name
Cardellina pusilla	Wilson's Warbler
Spizella arborea	American Tree Sparrow
Spizella passerina	Chipping Sparrow
Passerculus sandwichensis	Savannah Sparrow
Passerella iliaca	Fox Sparrow
Melospiza lincolnii	Lincoln's Sparrow
Zonotrichia leucophrys	White-crowned Sparrow
Zonotrichia atricapilla	Golden-crowned Sparrow
Junco hyemalis	Dark-eyed Junco
Euphagus carolinus	Rusty Blackbird
Leucosticte tephrocotis	Gray-crowned Rosy Finch
Pinicola enucleator	Pine Grosbeak
Loxia leucoptera	White-winged Crossbill
Acanthis flammea	Common Redpoll
Acanthis sp.	Redpoll sp.
Spinus pinus	Pine Siskin

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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